

New research highlights how cancer cells repair themselves following proton beam therapy

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Dr Jason Parsons. Credit: University of Liverpool

Collaborative research conducted in Liverpool and Oxford, published in *The Red Journal*, identifies the specific cellular process that helps cancer cells damaged as a result of proton beam therapy, repair themselves.

Proton beam therapy (PBT) is a type of radiation treatment that uses protons to treat cancer. A [proton](#) is a positively charged particle and a machine called a synchrotron or cyclotron speeds up the protons.

The protons' speed determines the energy level, and high energy protons travel deeper in the body than low energy ones. The key advantage of PBT is that it can deliver the radiation dose specifically to the tumour, and limits damage to normal, healthy tissue.

Low energy protons, in comparison to high energy protons, introduce increased levels of damage to the DNA that is in close proximity (called complex

DNA damage) which persists in [cells](#) and contributes significantly to the cell killing effects of PBT. The precise mechanism of how the DNA in the targeted cancer cell repairs itself has been until recently unknown.

Researchers from the University of Liverpool and Cancer Research UK / Medical Research Council Oxford Institute for Radiation Oncology conducted a study to identify the specific process that allows irradiated cancer cells following PBT to repair themselves.

The research, led by Dr Jason Parsons from the University of Liverpool, treated a number of different cancer cells to both high energy and low energy protons and measured the levels of complex DNA damage and how the [cancer cells](#) initiate their repair which correlates to their survival.

Part of the research was carried out at The Clatterbridge Cancer Centre's National Eye Proton Therapy Centre, home to the UK's only proton therapy beam

Dr Parsons, said: "With the increasing use of PBT in the UK for cancer treatment, stimulated by the UK Government's £250 million investment in PBT Centres in Manchester and London that will be operational from this year and 2020, respectively, our work has revealed new details on the radiobiology of protons at the molecular and cellular level.

"Using currently the only clinically operating [proton beam therapy](#) facility at The Clatterbridge Cancer Centre in Wirral, our research shows that protons at different energies display distinct effects on DNA which have a major impact on their efficiency in causing cancer cell killing.

"Low energy protons cause increases in complex DNA damage, which contributes significantly to decreased cell survival versus high [energy](#) protons and conventional x-ray irradiation."

Andrzej Kacperk Consultant Proton Physicist at The Clatterbridge Cancer Centre, said: "This is an important milestone in our understanding of proton beam therapy in the UK and abroad, and will help to guide further research in the near future, and hopefully identify ways of making PBT more efficient and effective for cancer [therapy](#)."

"Providing the technology for this research illustrates the importance of a collaborative approach in developing [cancer](#) treatment."

More information: Rachel J. Carter et al, Complex DNA Damage Induced by High Linear Energy Transfer Alpha-Particles and Protons Triggers a Specific Cellular DNA Damage Response, *International Journal of Radiation Oncology*Biophysics* (2017). [DOI: 10.1016/j.ijrobp.2017.11.012](#)

Provided by University of Liverpool

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